DESIGN AND CONSTRUCTION OF AN AUTOMATIC CHANGEOVER DC-AC POWER INVERTER WITH AUTOMOTIVE BATTERY CHARGER

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DEDICATION

This project is dedicated to my Lord and Saviour Jesus Christ. To Him be all glory, honour, adoration and thanksgiving.

DECLARATION

I ***IKWUE OGAH OKOH,*** declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copy right to the Federal University of Technology, Minna.

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ACKNOWLEDGMENT

Special thanks goes first and foremost to my God for His love, care and for giving me favour in life as well as success that I enjoyed.

I want to deeply appreciate my parents, ***Mr. & Mrs IKWUE A CHRIS,most especially my ever loving mother Mrs VICTORIA OCHANYABA O.*** for their support and care. I also acknowledge ***Mr.&Mrs GODWIN O.IKWUE*** and family for being there for me when I needed them most,to all my uncles, aunties ,brother & sisters,all my dear friends for their motivation and mental support, God bless and increase you. I thank my siblings, colleagues and friends for their care.

Special gratitude goes to my supervisor, ***Mr. Usman Abraham,*** for taking time to go through my work. I deeply give thanks to the members of staff of the Department of Electrical Engineering for their academic support. Thank you all.

ABSTRACT

As a result of fault and irregularities in electric power supply, it became very necessary to design and construct an automatic changeover DC-AC power inverter with charger to be used as a back-up or alternative power sources in other to check the regular interruption of power and to project the very sensitive electronic devices. The design of this electronic power generating device (Automatic changeover DC-AC power inverter with charger) involves the use of a 555 times IC which acts or function as an astable multivibrator generating or converting the DC to AC, transformer used in step down and step-up of voltages to required specifications, a lead acid battery, an automatic relay switching circuit. The device converts a D.C. of 12V to an A.C of 1KVA.

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CHAPTER ONE

1.0 GENERAL INTRODUCTION

Due to the power supply failure and other irregularities in power supply, most electrical appliances and Electronic devices in homes, offices, schools etc. are terribly affected in different ways in various activities. Since getting an alternative power supply such as a solar or electricity generating plant is difficult in terms of not being cost effective in purchasing and maintenance, and causing environmental hazards, there is a need for a cost effective, less hazardous alternative automatic change over uninterrupted power supply.These automatic change over system of power supply, helps to prevent devices from damages. Considering the power problems and challenges, an automatic change over DC-AC power inverter with automotive battery charger is needed.

Although electrical energy cannot be stored in the AC form but in DC form [1], the DC form stored in a lead acid battery is converted into an AC form using an inverting device (a 555 timer IC in an astable mode), a CMOS circuit, a step-up transformer. There are three (3) main circuitry involved in this inverter; a 555 timer oscillator circuit in an astable mode of operation with a 4013 phase splitting IC, a power CMOS circuit connected in parallel with a step-up voltage transformer, a step-down voltage transformer with an automotive batter charger circuit. This makes it less tedious, neater, satisfactory, portable and most convenient to design.

1.1 AIMS AND OBJECTIVE

The fundamental reasons for the design and construction of this project are:

1. Majorly to solve the problem of unsteady and interruption of power supply.
2. To design and construct a reliable and cost effective, efficient and uninterrupted power supply device.
3. To support the economic activities of the society.

Also, the basic targets for the project are:

4. To bring to the knowledge and understanding of the principles and possibilities for the design of an automatic change over DC-AC power inverter.
5. To achieve a certain level of energy conservation from the main supply (PHCN) to restore the potential energy of the battery after using its power.
6. To have the inverter convert incoming DC to AC and then step-up the resulting AC to main voltage level using a transformer.

1.2 METHODOLOGY

Considering the adverse challenges in the power sector, motivated the design of the automatic changeover DC-AC power inverter with automotive battery charger. From Fig. 1.0. It can be seen that the AC mains is stepped down by the transformer to the specified 12V, passing through the charging circuit for the restoration of the discharged 12V lead acid battery which will discharge 12V DC supply when there is no A.C mains supply through the 555 timer oscillator in an astable mode of operation combined with the power CMOS circuit, gives a trimmed frequency of the inverted D.C power into A.C power supply. These A.C power supply from 555 timer oscillator and power CMOS is stepped-up by a transformer great in output to be utilized by the A.C load. In the case, where there is an A.C mains supply, the D.C supply automatically cuts-off leaving the A.C mains supplying the load through the relay circuit.

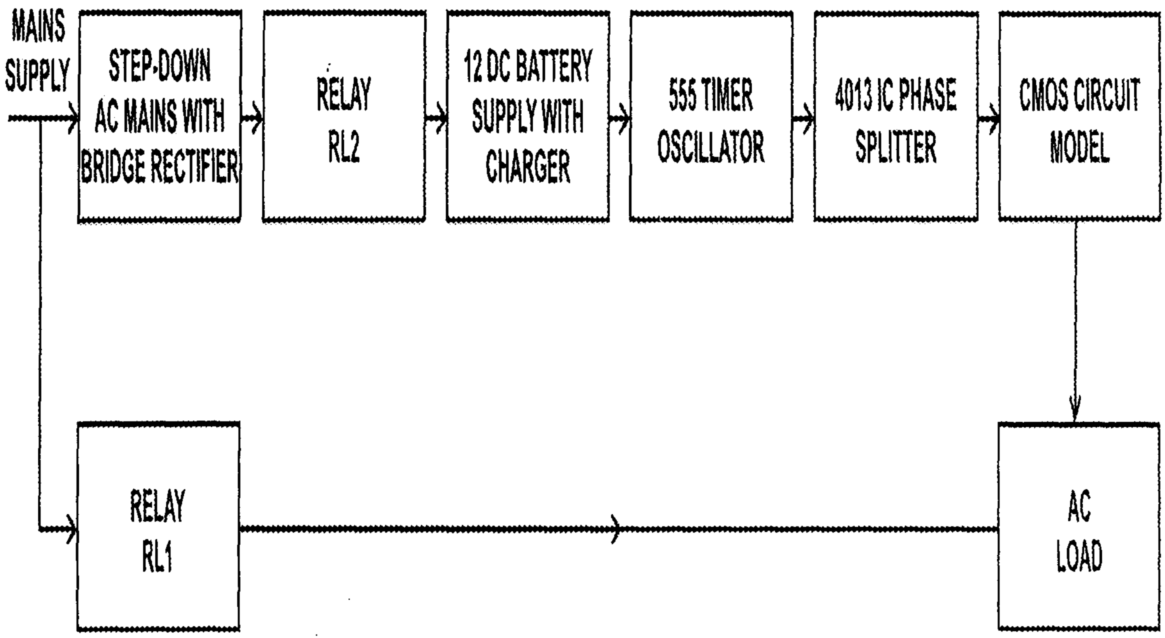

Fig.1.0.BLOCK DIAGRAM OF THE AUTOMATIC CHANGEOVER DC-AC POWER INVERTER WITH AUTOMOTIVE BATTERY CHARGER .

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.0 THEORETICAL BACKGROUND

Power electronics devices are specifically designed diodes and transistors that have the ability to carry large currents and sustain large voltage. Hence, the D.C to AC power inverter is a class of power electronic device that converts fixed DC voltage to a variable frequency and variable amplitude AC voltage; it could be single phase or multiple[1].DC – AC inverters are electronic devices used to produce mains voltage AC power from low voltage DC energy (from a battery or solar panel), this device is needed when the usual AC mains power is not available.

DC – AC inverters are made up of mostly semi-conductors such as transistors, resistors, diodes and in most recent times in advance technology, integrated circuits (555 timers IC, 741 IC, 7812 IC etc) are used in the network; to bring about miniaturization, portability and more effective design and functionality. Although inverters produces variable frequency and amplitude AC voltage equivalent to the normal usual AC mains from the National grade, it is not compatible to some electrical appliances e.g. refrigerators, freezers, air-conditioners or any appliance where a motor is driving a compressor or pump[2].

Inverters are classified into the three basic types, based on the nature or their output wave form[2]:

- Square or rectangular wave inverters; produces a rectangular wave form, has less power consumption.
- Pure sine wave inverter; the output is a pure sine wave form, consumes more power but more effective as the output is equivalent to the usual AC mains supply. Though difficult to realize.

- Modified sine wave inverter; the combination of both rectangular and sine wave waveform, is more easy to realize than the pure sine wave and more steady than the rectangular wave form type.

2.1 HISTORICAL BACKGROUND

The technology of the science of power electronics was carried out first in 1983 by an American Company called the HEART INTERFACE to produce an inverter circuit technology[3].The components used in building this inverter circuit were mostly analogue electronic components, it was as years passed by precisely in the 1990's when it was technologically improved on differs manufacturing companies using a power MOSFET as a main power output to the step-up transformer. Power MOSFET was used to make the design smaller even as at late 1990's, IC's were also used to place some of the analogue components that dissipate much heat and power.

2.2 DISCUSSION ON PREVIOUS WORKS

As stated previously, the HEART INTERFACE company used mostly analogue electronic component that brought about (initiations such as dissipation of heart, consumption of power and a challenge of size (too bid). Although these gave the foundation for the nowadays improved and advanced works on inverter.

The work down by my fellow colleagues in the department of electrical and computer engineering in Federal University of Technology, Minna also show a bit of improvement, though most analogue electronic components were used, examples of such are: Design and Construction of an Automatic changeover 900VA DC-AC inverter with charger (years 2003) by VITUS PAUL NWAEZE, Design and Construction of inverter and charger (year 2004) by AGBACHI E. OKENNA etc. The above listed projects were improvement of inverter circuits because they used digital components for proper functionality and safty.

Electus distribution, a company in the U.S a manufacturer of DC-AC converter with continuous output ratings varying from 60watt – 920watts at 230V.According to electus distribution, there are some basic challenges to be considered while constructing an inverter.these factors includes:

- OUTPUT REGULATION:Though the mains power is well regulated because the power system has enormous generating plants, automatic regulation systems to keep the mains voltage and frequency very closeto constant, despite load variations of many megawatts,inevitably these kind of performance is difficult to get from smaller electronic inverter .connected to a modest battery or solar panel as the energy source.To get a well regulated system in an inverter, it depends on the battery voltage and transformer's step up ratio,hence, the regulation is achieved in two ways; by varying the width of the pulses generated,control the form factor and hence the RMS value of the output voltage.
- VOLTAGE SPIKES:Another factor of the fairly high harmonic content in the output is that appliances and tools with a fairly inductive load impedance can develop fairly high voltage spikes due to inductive back EMF.These spikes can damage the MOSFETS and their driving circuitry because the spikes are passed through to the primary of the inverter's transformer.There are two ways to prevent this;connecting a pair of high power zener diodes across the MOSFETs,and to have a high power standard diodes connected from each end of the primary to a large electrolytic capacitor, which becomes charged up twice the battery vcoltage.

- CAPACTIVE LOADING:The problem is that when lights are connected to an inverter with output rich in harmonics, the shunt capacitor doesn't just 'correct' the power factor, but drastically over correct as a result the flouro assembly draws a heavily capacitive load current, and can easily over load the inverter.Usually the solution is to either remove their power correction capacitors altogether or replace them with a much smaller value.
- FREQUENCY STABILITY:To avoid this problem, most DC-AC inverter include circuitry to ensure that the inverter 's output frequency stays close to the norminal mains frequency(50Hz).this circuitry can be achieved by using a quartz crystal oscillator and divider system to generate the master timing for the MOSFET drive pulses or a stable oscillator with R-C timing, fed via a voltage regulator to ensure that frequency doasn't change even if battery voltage varies quite widely.

CHAPTER THREE

3.0 DESIGN AND IMPLIMENTATION

This involves the actual design breakdown of the entire circuit system into various design modules. There are three basic design modules; the 555 timer oscillator inverting with a 4013 phase splitter modules, power CMOS circuit model and step-up transformer module, step-down transformer and automotive battery charger module. All three modules are internet worked to form a complete operating and functional system, that is an automatic changeover DC to AC power inverter with automotive battery charger system.

3.1 THE 555 TIMER OSCILLATOR INVERTING MODULE

The 555 timer oscillator provides a free running oscillation (i.e. astable mode operation) which requires three or more external components. A 555 timer IC contain two voltage comparator, a bistable flip flop, a discharge transistor, a resistor divider network and an output amplifier with up to 200mA current capability. There are three divider resistors and each is 5KΩ. This divider network sets the threshold comparator trip point to 2/3Vcc and the trigger comparator at 1/3Vcc[4].

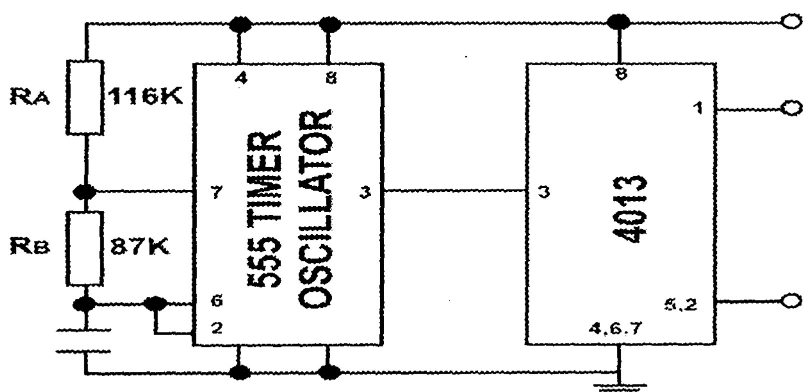

FIG.3.1a 555 TIMER OSCILLATOR INVERTING CIRCUIT MODEL.

3.1.1 DEFINITION OF PIN FUNCTION OF A 555 TIMER

PIN 1 (Ground): The ground (common) pin is the most negative supply potential of the devices, which is normally connected to circuit common (ground) when operated from positive supply voltages[4].

PIN 2 (Trigger): This pin is the input to the low comparator and used to set the latch, which in turn causes the output to go **high.** Triggering is accomplished by taking the pin from above to below a voltage level of 1/3Vcc (Vcc=12v).The trigger pulse must be of shorter duration than time interval determined by the external R(Resistor) and C(capacitor).Precaution taken was, the trigger input signal must not remain lower than 1/3Vcc for a period of time longer than the timing circle and at the storage time in the lower comparator. The voltage range that can safely be applied to the trigger Pin is between Vcc and ground. The typical current is about 500Na[4].

PIN 3 (Output): The output of the 555 comes from a high current to tem-pole stage made up of transistors Q20-Q24. Transistor Q21 and Q22 provide dive of source-type loads, and their darlington connection provides a high state output voltage about 1.7volts less than Vcc supply level used. Transistor Q24 has a low saturation voltage, which allows it to interface directly with good noise margin when driving current-sink Logic. However, High state voltage level is typically 10.3voltas at Vcc-12volts. Both the rise and fall times of the output wave form are quite fast, typical switching times being 100ns[4].

PIN 4 (Reset): This Pin is also used to Reset the latch and return the output top a low state.The reset voltage threshold level is 0.7volt and a sink current of 0.1mA from this Pin is required to reset the device; thus the reset input is TTL compatible for any supply voltage. Regardless of the state of either of the other inputs, the reset Pin is used to reset the flip-flop that controls the state of output Pin 3, this Pin is activated when a voltage level anywhere between 0 and 0.4volt is applied to the Pin. To avoid any possibility of false resetting, the reset input is tied to Vcc[4].

PIN 5 (Control Voltage): This Pin allows direct access to the 2/3 Vcc voltage-divider points, the reference level for the upper comparator. It also allows indirect access to the lower comparator, as there is a 2:1 divider from this point to the lower comparator reference input, Q13. When used in the astable mode, the control voltage can be varied from 1.7volt to the full Vcc. When Pin 5 is not used; it is grounded with a capacitor of about 0.01 μF for immunity to noise since it is a comparator input[4].

PIN 6 (Threshold): Pin 6 is one input to the upper comparator and is used to reset the latch, which causes the output to go low. Resetting via this terminal is accomplished by taking the terminal from below to above a voltage level of 2/3Vcc. The voltage range that can safely be applied to the threshold Pin is between Vcc and ground. A DC current termed the threshold current must also flow into this terminal from external circuit, this current is typically 0.1μA and will define the upper limit of total resistance allowable from Pin 6 to Vcc. For 12 volts operation the maximum value of resistance is 20MΩ[4].

PIN 7 (Discharge): This Pin is connected to the open collector of a npn transistor Q14, the emitter of which goes to ground so that when the transistor is turned "ON".It is "ON" when the output is low and "OFF" when the output is HIGH. Saturation voltage is typically below 100mV for currents of 5mA or less and off-state leakage is about 20nA[4].

PIN 8 (Vcc): This is the positive supply voltage terminal, V+, of the 555 timer IC supply voltage operating range is +4.5 volts (minimum) to +18volts (Maximum).

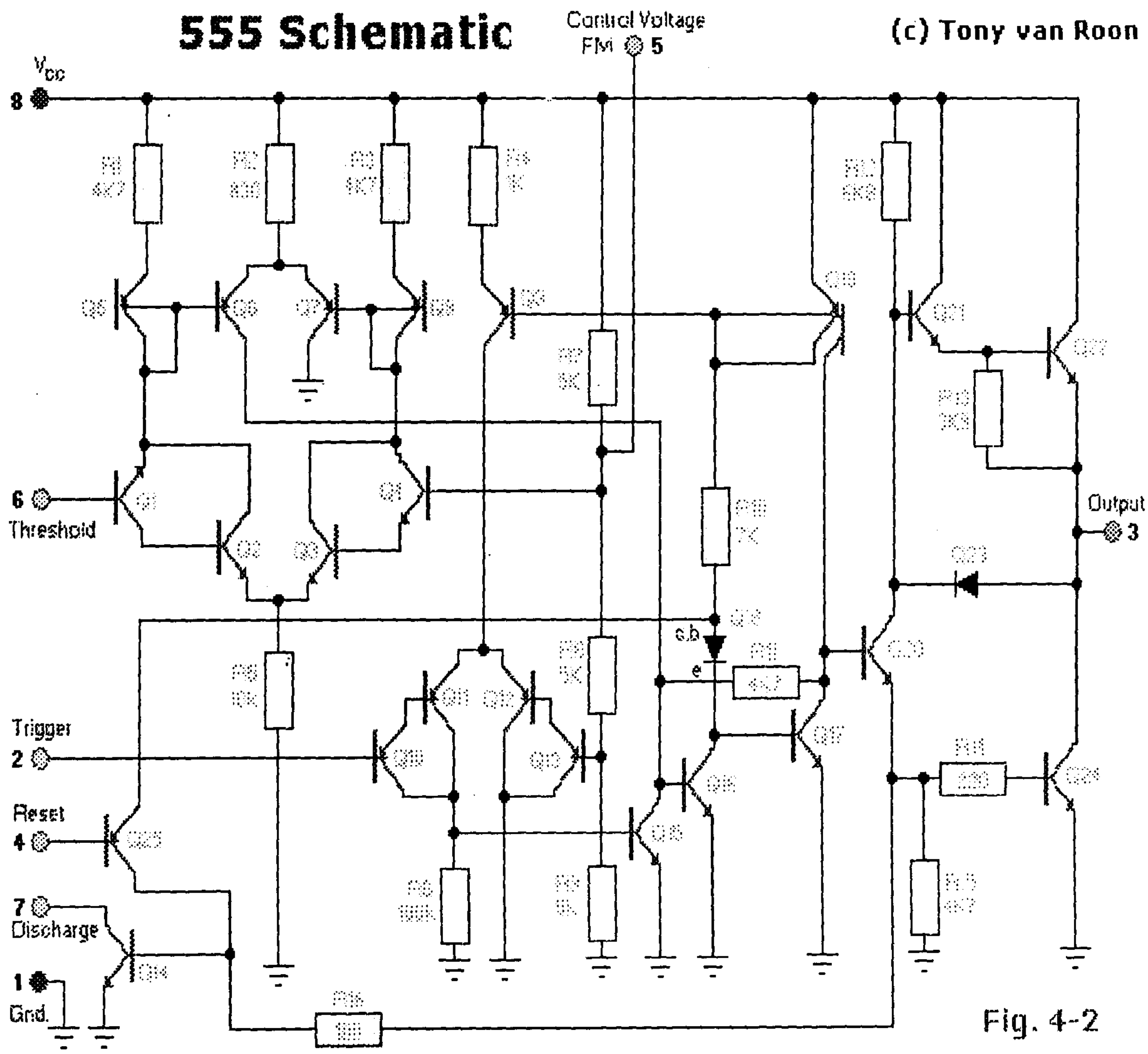

FIG 3.1b A SCHEMATIC DIAGRAM OF A 555 TIMER IC

3.1.2 DESIGN CALCULATION AND 555 TIMER OPERATION

These forms the basic calculation for the value of the Resistors, capacitors (for R-C) network), period, T, and frequency used for the proper functionality of the 555 Timer to give the necessary output.

Let require frequency, f = 50Hz (Standard Specification).

Capacitor, C = 0.1uf (555Timer Specification).

Period, $T = \frac{1}{F} = \frac{1}{50} = 0.02sec$

Let this: time the output will be held high = $T_H = 0.69\ (R_A + R_B)\ C$

Time the output will be held low = $T_L = 0.69\ (R_B)C$

Total period, $T = T_H + T_L$. Putting $T_H = 0.014$ i.e. D = 70%

where, D = Duty cycle; the percentage of time the output is high for a Rectangular wave form $= \frac{R_A + R_B}{R_A + 2R_B} \times 100\%$

$$T = 0.02 = 0.014 + T_L$$

$$T_L + 0.02 - 0.014 = 0.006sec$$

But from $T_L = 0.69\ (R_B)\ c = (0.69x0.1x10^{-6})R_B$

$$R_B = \frac{T_L}{6.9X10^{-8}} = \frac{0.006}{6.9X10^{-8}} = 86956.5 = 87K\Omega$$

Putting RA into TH $= 0.69\ (R_A = R_B)C = 0.69x0.1x10^{-6}$

$$R_A = 0.014 - \frac{(6.9x10\text{-}8x87x10^3)}{6.9x10^{-8}} = \frac{0.014 - 6.003\ x\ 10^{-3}}{6.9\ x\ 10^{-8}}$$

$$R_A = \frac{7.997\ x\ 107^{-3}}{6.9x10^{-8}} = 115898 = 116K\Omega$$

$$D = \frac{116x10^3+87x10^3}{116x10^3+87x10^3}\ x\ 100\% = \frac{203000}{290000}\ x\ 100\% = 0.7\ x\ 100\% = 70\%$$

Using $f = \dfrac{1.45}{(R_A+2R_B)C} = \dfrac{1.45}{[116x10^3+2(87x10^3)]x0.1x10} = 50Hz$

Operation: Given Vcc = 12V,the trigger point will be 4V(1/3Vcc) and the threshold point 8V (2/3Vcc). When **Pin 2** goes below 4V, the trigger comparator output switches states and sets the flip-flop to the HIGH state and output **Pin 3** goes HIGH. If **Pin 2** returns to some value greater than 4V, the output stays HIGH because the flip-flop "remembers" that it was set. Now, if **Pin 6** goes above 8V, the threshold comparator switches states and resets the flip flop to its low state; this does two things: The output (Pin 3) goes low and the discharge transistor in turn ON. Note that the output of the 555 timer is digital, it is either high or low. **Pin 6** is normally connected to a capacitor C, which is part of the external RC timing network. When capacitor voltage exceeds 2/3Vcc, the threshold comparator resets the flip flop to the low state, turning on the discharge transistor discharging the external capacitor in preparation for another timing cycle. **Pin 4,** the reset gives direct access to the flip flop. This Pin overrides the other timer functions and Pins. Since the Reset function is ordinarily not needed, Pin 4 is typically tied to Vcc, it drives output Pin 3 when it resets the flip flop and turns on the discharge transistor.

The trigger Pin2 is tired to the threshold (Pin 6). It begins, when charging through the series combination of R_A and R_B. When capacitor voltage reaches 2/3Vcc, the output drops low and the discharge transistor comes on. The capacitor now discharges through R_B, when the capacitor reaches 1/3Vcc, the output switches high and the discharge transistor is turn off. The capacitor now begins charging through R_A and R_B again, the cycle will repeat continuously with the capacitor charging and discharging with the output switching HIGH and LOW.

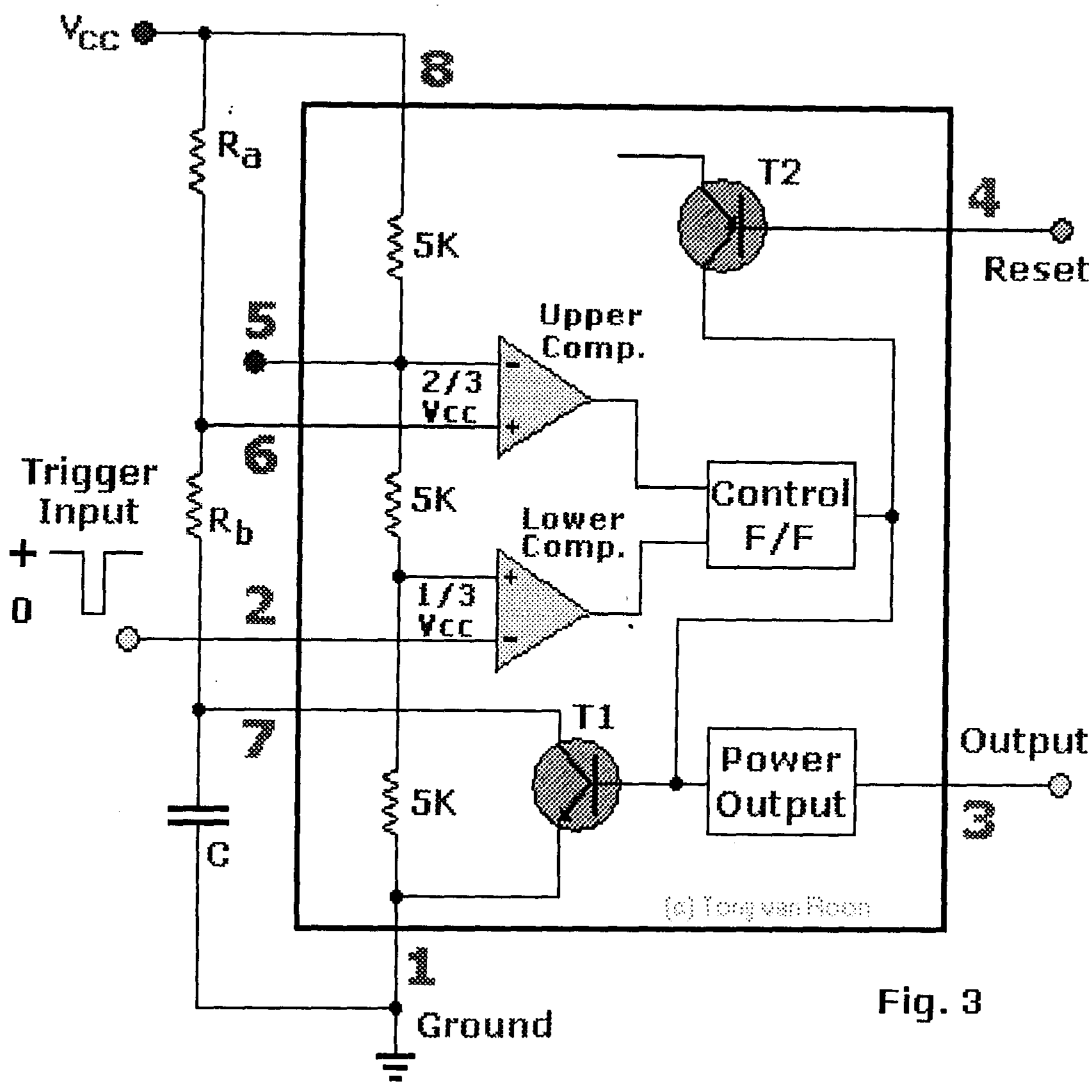

FIG.3.1c A BLOCK DIAGRAM OF A 555 TIMER OSCILLATOR IC.

3.2 POWER CMOS CIRCUIT MODEL WITH STEP-UP TRANSFORMER MODULE

The CMOS circuit shows in Fig. 3.2 operates on the basis of a control voltage (V=12V) that can be either "LOW" (OV) or "HIGH" (Vin>Vt), where Vt is the threshold voltage. These circuit operates when the output from the 4013 phase spliter IC goes through path A as a "HIGH" into the gate (Q_{IA}, Q_{IB}, Q_{IC}) of the upper CMOS (see fig. 3.2) connected in parallel (i.e Vin is "HIGH" for path A). And a "LOW" input through path B into the Lower CMOS (Q_{2A}, Q_{2B}, Q_{2C}) connected also in parallel (i.e. Vin IC "LOW" for path B).

The transmission gates (Q_{IA}, Q_{IB}, Q_{IC}) will be "ON" providing a conducting path between the input and the output. This is because with Vin HIGH the conducting transmission gate provides near-zero-resistance (typically tens of ohms) with values of voltage ranging from OV to Vcc (V+). These operations will repeat itself with respect to the output of the 4013 phase splitter IC as it goes "HIGH" and "LOW" for both the upper and lower group of CMOS at different period or cycle[6].

After these operation (i.e the output of each collective CMOS switching circuit) the step-up transformer steps the input voltage (the latters output) up to suit the required output power (voltage).

Transformer calculation:

Let:

N_1 = Ration of Primary tunrs = 1

N_2 = Ratio of secondary turns = ?

E_1 = Primary side voltage = 12V

E_2 = Secondary side voltage = 230V

I_1 = Primary current = (Battery current)

I_2 = Secondary current (Output current)

P_1 = Primary power

P_2 = Secondary power (Output power) = 1000watts

Using $\frac{E_2}{E_1} = \frac{N_2}{N_1}$ for transformer ratio

$\frac{230}{12} = \frac{N_2}{1}$ $N_2 = 19.17 = 20$

transformer ratio = 1.20 i.e $N_1 : N_2$

Using : $I_1 V_1 = I_2 V_2 = F_2 = 1000$ walts

But $I_2 (230) = 1000$

$$I_2 = \frac{1000}{230} = 4.35 \text{ A (out put current)}$$

from $I_1 V_1 = I_2 V^2$

$$I_1 = \frac{I_2 V_2}{V_1} = \frac{4.35 \text{x} 230}{12} = 83.375\text{A (In put current)}$$

Battery current or Transformer Primary Current, $I_1 = 83.375$A

Transformer Secondary Current or output Current, $I_2 = 4.35$A

Transformer Ratio, N = 1:20 (i.e N_1: N_2).

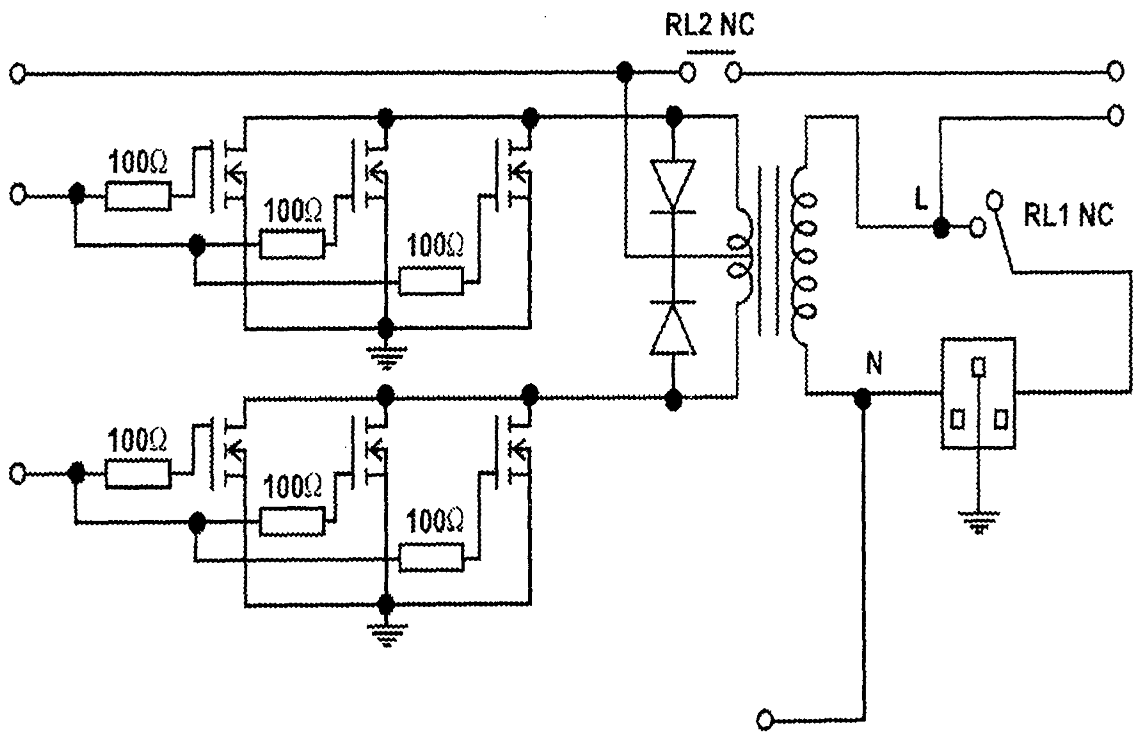

Fig. 3.2 *POWER CMOS WITH TRANSMISSION GATE AND STEP-UP TRANSFORMER*

3.3 STEP-DOWN TRANSFORMER AND AUTOMOTIVE BATTERY CHARGER MODULE

From the fig. 3.3, the charging circuit is connected to a standard 230V mains supply which is step down by the transformer and passed through a voltage bridg]e rectifier and through a voltage regulator (7812). The charging unit comprises of an under-voltage unit set at 9V using a Zener diode and transistor, an over-voltage unit set at 12V (or a bit above 12V) using an op-amp.

When there is power from mains, RLI (that is normally open) it energized to cut-off the use of the battery using RL2 (which is normally close) to switch to the mains through RL1. At the under-voltage unit of the charger, RL3 (which is normally opened) is activated by transistor TR1 which is biased by 9V zener diode, when the TR1 is biased, it closes RL3 up to power up the inverting unit, if voltage reduces below 9V, it will cut-off (opening RL3) supply to the inverting unit. Also, at the over-voltage unit during charging period, if it gets top 12V (or a bit over 12V) as deduced by the op-amp, it cuts-off RL4 (which is normally close) charging point from battery. Hence, the circuit has a built in under-charging and overcharging protection.

Battery charging unit calculation.

Battery Charging Unit Calculation

From TRANSISTOR TR_2

Using : $hfe = \frac{IC}{I_B}$ where Ic = IA; hfe = 100

Base current $I_B = \frac{Ic}{hte} = \frac{1.0}{100} = 10mA$.

but V= I.R = $I_B R_B$ where V= 12V

$$R_B = \frac{V}{I_B} = \frac{12}{10x10^{-3}} = 1.2k$$

For Zener diode, Z_1

Let I_1 = step down Transformer current = 500mA

V = step down Transformer voltage = 12V

$R_0 = \frac{V}{I_z}$ where I_z = zener diode current = 1.5 mA

$R_0 = \frac{12}{1.5\times10^{-3}} = 8k$

Hence, $R_z = \frac{V - V_z}{I_z}$ where V_z = diode voltage = 9V (Minimum Voltage

$R_z = \frac{12 - 9}{1.5\times10^{-3}} = \frac{3}{1.5\times10^{3}} = 2k$

For Zener diode, Z_2

Let V_x = Voltage before 7812 Ic = 15v

Using : $R_z = \frac{V - Vz}{I_z}$ where Vz = Maximum charging voltage = 12v

$Rz = \frac{15 - 12}{1.5\times10^{-3}} = \frac{3}{1.5\times10^{3}} = 2k$

for capacitor, Co

using: Q = CV = I,t

but $t = \frac{1}{f} = \frac{1}{100Hz} = 0.01$ sec.

Recall that: V= 15v; I_T = 500 mA

$Co = \frac{I\,t}{V} = \frac{500\times10^{-3} \times 0.01}{15} = 3.33\times10^{-4}F.$

but for proper and standard functionality C_o = 1000 uF.

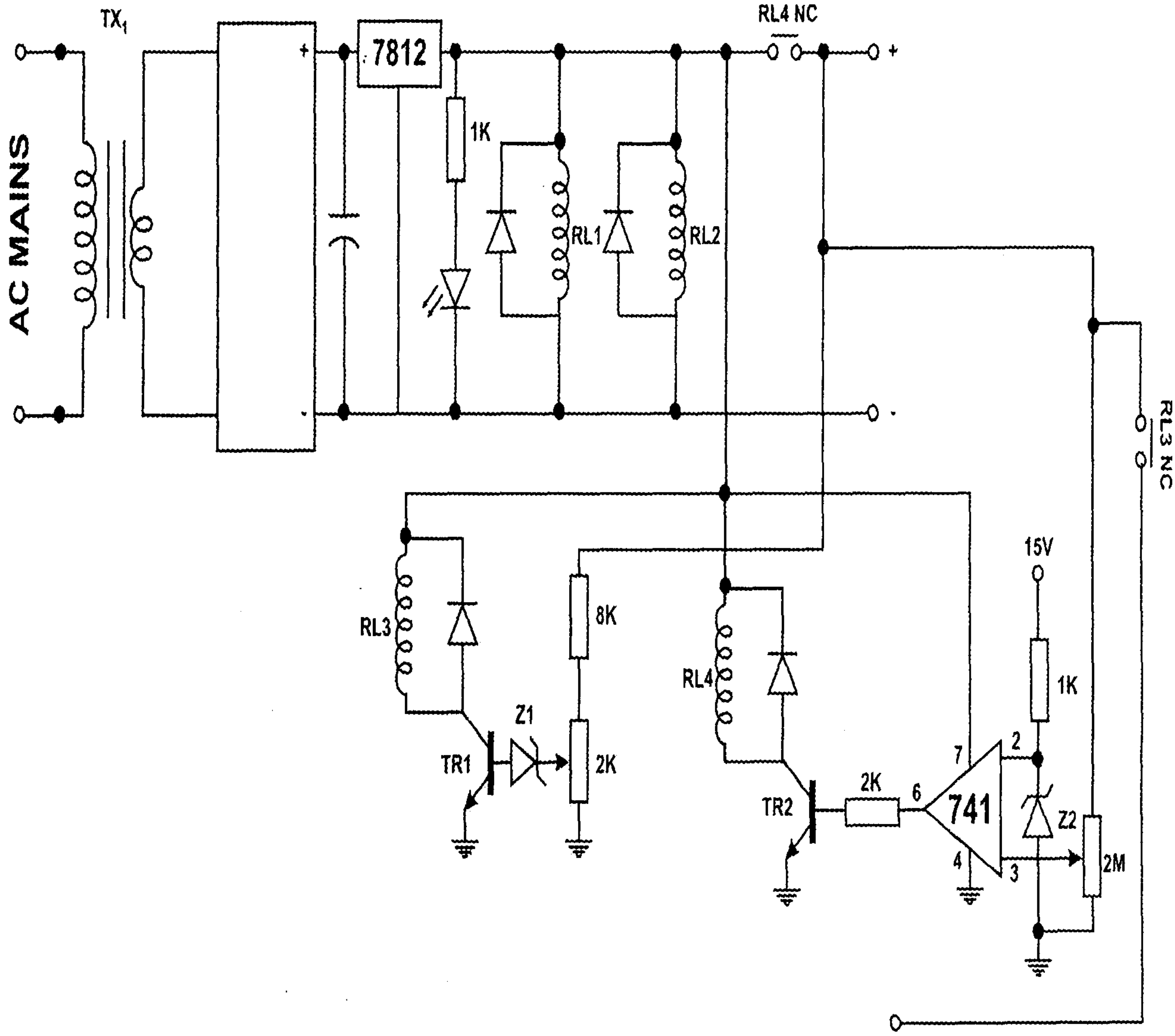

FIG.3.3 STEP DOWN TRANSFORMER AND AUTOMOTIVE BATTERY CHARGER CIRCUIT MODEL

CHAPTER FOUR

4.0 TEST, RESULT AND CONCLUSION

4.1 MODIFICATION

From past projects on a DC-AC power inverter, electronic components such as bipolar transistors (BJT), oscillator circuit, diodes are mostly used in the design and construction. In the case of this project power CMOS in used in the place of a bipolar transistor which dissipate heat more than a power CMOS does, power CMOS is also more efficient and effective in power supply. A 555-timer oscillator IC with a 4013 IC was used in place of the oscillator circuit that comprises of some components such as diodes BJT, capacitors, resistors etc.

With the modification of automatic switching to self-charging mode and power discharging mode of both the battery and the inverter.

4.2 TESTING AND OBTAINED RESULT

At the point fixing the 555 timer oscillator and 4013 IC, the output was a 12V rectangular wave form when tested with multinuclear and an oscilloscope. On testing the on board power CMOS, it was deduced that the power output of each as 150 watts, the over-voltage and under-voltage points in the charging circuit model was tested and the under-voltage was 8.5V, over voltage was a bit above 12V.

Measuring the output voltage power at the end of construction it was deduced to be approximately 1150 w.

4.3 DISCUSSION OF RESULTS

The results of the test obtained, were not the actual values that was expected and this is because of some factors associated with some of the electronic components example the out power was affected by power factor, heat dissipation; temperature variation on components like resistor, diodes etc.

CHAPTER FIVE

5.0 CONCLUSION

5.1 PRECAUTIONS

1. Polarities of components were considered before connecting them to prevent component damages of proper sequence of operation.
2. Necessary portions of the electronic board were isolated to avoid continuity, which may result in short circuit.
3. Soldering of components was neatly sucked out avoid dirty soldering work on electronic board.
4. The circuit was isolated from all forms of moisture to avoid any mal function.

Below are some safety risk associated with DC-AC inverter 's:

- Many people assume that because an inverter is operating from a norminal 12V battery and it can't deliver as much output as a normal mains power outlet , it's relatively safe.Even a low power inverter rated at amere 60 watts has an output which is potentially fatal, such inverter can typically deliver up to about 360Ma at 230V, which is over ten times the current level needed to stop the heart and cause fatal fibrillation.
- Another is one which arises from the fact that in many inverter s, thers's a direct electricalpathg between the mains voltage output circuit and the low voltage input circuitry.This internal current doesn't pose any risk when inverter is powering a single tool.

5.2 RECOMMENDATION

Indeed this project is an improvement of past DC-AC power inverter, because some of the components, through few in number compared to past project but make it more effective and efficient. Despite this improvement, it said that greatest biggest room in life is the room for improvement. Hence, it is advice able in improving this project, the use of a micro controller chip, a 8051 microcontroller or MC6800 microcontroller. With the use of a microcontroller chip programmed for the necessary operation of the inverter device with the use of few components such as the transformer, power CMOS etc.

It is also recommended, to use a crystal oscillator, which was to discovered to give about 99% performance compared to the 555 timer oscillator.

5.3 PROBLEM ENCOUNTERED

At the course of design and contraction, some problems were encountered:

- Challenge of National Power Outage.
- Unavailability of Electronic Components in the Market.

5.4 SUMMARY

The design of an Automatic changeover DC-AC power inverter with automatic batter changer is to improve and add value to the failing power system of the society which was actually achieved. From the result of the out put voltage of the device it was deduced to be 1000w (IKVA); meeting the specified and required aim of the project.

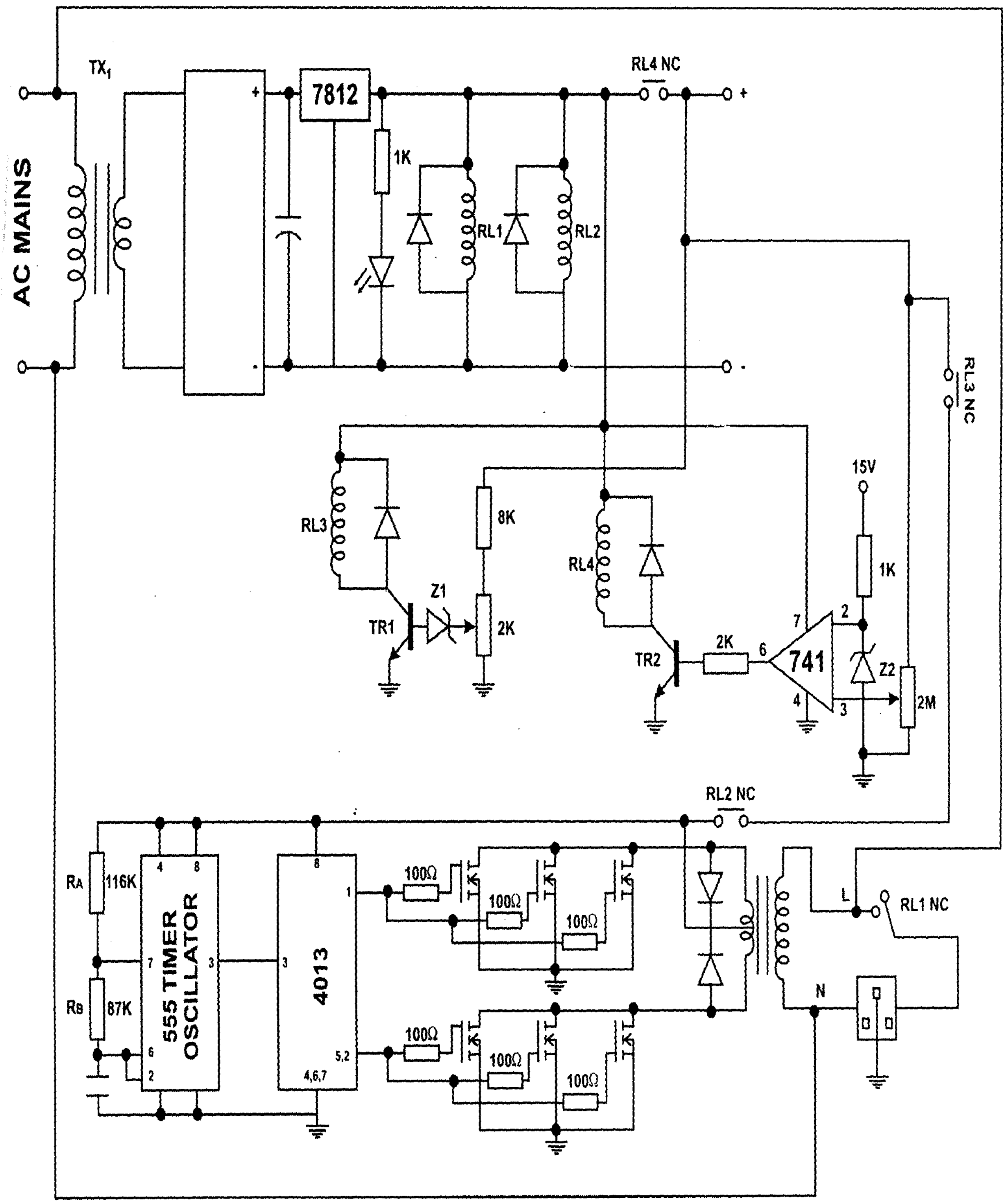

FIG. A. COMPLETE CIRCUIT DIAGRAM FOR THE AUTOMATIC CHANGE OVER D.C-A.C POWER INVERTER WI'I AUTOMOTIVE BATTERY CHARGER

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